LED device could increase memory retention among astronauts

May 29 2019

Hanli Liu, professor of bioengineering at The University of Texas at Arlington. Credit: The University of Texas at Arlington

Hanli Liu, a professor of bioengineering at The University of Texas at Arlington, is working to improve memory and cognitive function in astronauts during space missions by directing light onto their brains.

Liu is co-primary investigator on an $800,000 NASA grant with Jacek Dmochowski, assistant professor of bioengineering at City University of New York, that will deliver a light-based technology to increase the energy available to brain cells and improve astronaut performance. UTA's share in the grant is $321,608 for two years.

Liu researches how to use lasers to deliver near-infrared light to the human brain to detect traumatic brain injuries and symptoms of post-traumatic stress disorder. Her recent work has broadened to investigate the neurophysiological principle of non-invasive delivery of near-infrared laser light to improve human cognition. This research has led to an understanding of how light can stimulate mitochondria, which are the powerhouses within cells, into creating more oxygen in the brain to increase cerebral metabolism and mitigate memory loss.

With the new grant, Liu will investigate whether light-emitting diodes, or LED, can replace lasers as the delivery method for near-infrared light. Specifically, she will find the wavelength range and duration necessary to produce the desired effects.

In general, lasers are heavy and bulky and would take too much space in the cramped quarters of a spacecraft or space station. LEDs are lighter and smaller and could be attached to a headband or similar device more easily stowed. Also, light delivered by LED is safer to human eyes than light from lasers.

LED light in the red and near-infrared range is already in widespread use for relieving pain and treating acne, although few researchers have rigorously investigated its feasibility and limitation for boosting and stimulating brain metabolism.

"Researchers have evidence that memory can be improved right after shining light on specific areas of the human brain for eight to 10 minutes," Liu said. "We are trying to demonstrate that if we can increase power in LEDs within safe levels, we can make LED light reach the cortex, just like a laser, but safer, smaller, easier and more portable to use."

Liu's research is an example of health and the human condition and data-driven discovery, two themes of UTA's Strategic Plan 2020: Bold Solutions | Global Impact, said Michael Cho, chair of the Bioengineering Department.

"Workplace pressure is difficult to deal with on Earth, but adding the stressors of an environment such as space can have negative effects and impacts on performance and memory," Cho said. "Dr. Liu's research has made important strides in this area, and if she is successful, her work on this new grant could be a crucial component of long-duration space exploration."

Liu's recent technology-based research and development is related to non-invasive transcranial infrared brain stimulations, or TIBS, In 2016, she led a team that published groundbreaking research in Nature's Scientific Reports that explained the underlying principle of TIBS, followed by another high-impact article in the Journal of Cerebral Blood Flow and Metabolism. This publication has provided the first demonstration that TIBS can significantly improve metabolic activity, blood flow and blood oxygenation in the human brain.

She also teamed with Alexa Smith-Osborne, a retired UTA associate professor of social work, and used functional near-infrared spectroscopy to map brain activity responses during cognitive task performance related to digit learning and memory retrial. This optical mapping method permits neural scientists and/or clinicians to "see" where memory fails within the brain among student veterans with post-traumatic stress disorder.

Provided by University of Texas at Arlington

Citation: LED device could increase memory retention among astronauts (2019, May 29) retrieved 21 June 2024 from https://phys.org/news/2019-05-device-memory-retention-astronauts.html